Winter 2010/2011 Climate Summary For Southwest Lower Michigan

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The winter of 2010-2011 (December through February) was mostly cooler than normal (Table 1). Specifically, December was near normal, January colder than normal, and February near normal. Precipitation was near normal overall; however, snowfall was above normal across the area.

The official National Weather Service forecast for December 2010 through February of 2011 for Southwest Lower Michigan from the Climate Prediction Center (CPC) called for an equal chance (EC) for above, below, or near normal temperatures and a greater chance for above normal precipitation and snowfall." The snowfall forecast was correct. The temperature forecast technically was correct, since an equal chance for all three possible outcomes was forecast.

TABLE 1. Reported temperature and precipitation for the winter of 2010/2011 at selected climate stations in Southwest Lower Michigan. Normals are computed from 30-year averages from 1971-2000.

Location		Temperature (F)	Precipitation (inches)	Snowfall (inches)
Grand Rapids	*Reported*	24.8°	6.05	70.8
	Normal	25.0°	6.27	52.1
	Departure	-0.2°	-0.22	18.7
Lansing	*Reported*	22.6°	4.89	51.0
	Normal	24.2°	5.23	37.8
	Departure	-1.6°	-0.34	13.2
Muskegon	*Reported*	25.7°	7.80	103.1
	Normal	25.8°	6.44	82.0
	Departure	-0.1°	1.36	+21.1

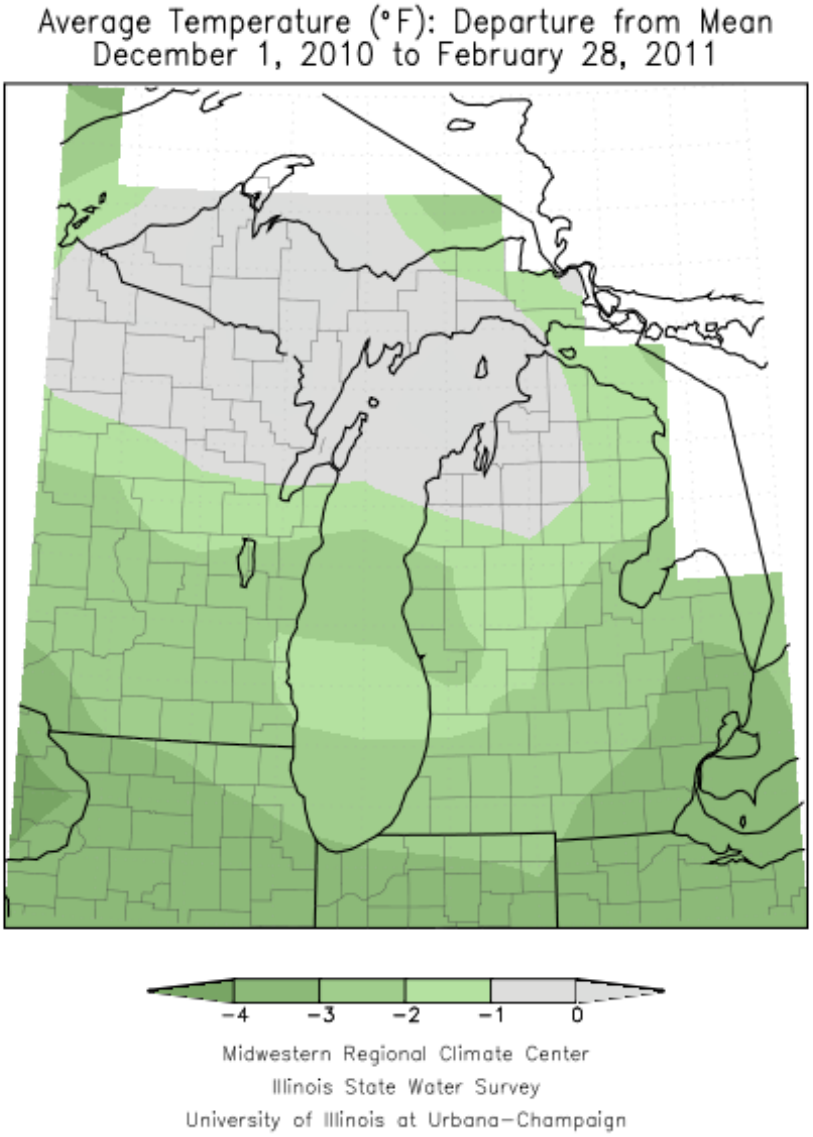


Figure 1. Winter 2010/2011 daily mean temperature departure from normal for Michigan.

The winter of 2010-2011 was the first winter since 2008-2009 to have three or more consecutive days with highs below 20 degrees (January 21-23) and to have lows across Southwest Lower Michigan falling below zero (January 23). From January 19th through February 11th, the high temperature stayed at or below freezing across Southwest Lower Michigan; this period of 24 consecutive days was the longest period of days with temperatures at or below freezing since January of 1979, when the 25th concluded a period of 25 consecutive days at or below freezing. All three primary climate stations recorded a much higher frequency of days with high temperatures at or below 32 degrees (Table 2). At both Lansing and Grand Rapids the last winter to have more days with at or below freezing was the 1977/1978 winter. Muskegon has to go back to 1995/1996 for a winter with more days with highs at or below freezing.

TABLE 2. Winter 2010/2011 temperature frequencies at the primary climate stations.

Number of days	Grand Rapids	Lansing	Muskegon
highs ≤ 32 (2010)	62	70	61
highs ≤ 32 (2009)	55	61	53
highs ≤ 32 (normal)	46.8	46.0	44.4
highs ≤ 32 (record)	70	74	73
year(s) of record	1977/1978 1919/1920	1919/1920 1903/1904	1903/1904
lows ≤ 32 (2010)	84	87	84
lows ≤ 32 (2009)	83	86	84
lows ≤ 32 (normal)	82.4	82.6	80.9
lows ≤ 32 (record)	91	91	90
year(s) of record	1919/1920	1867/1868,1887/1888 1919/1920	1958/1959,1944/1945 1919/1920,1903/1904
lows ≤ 0 (2010)	2	3	1
lows ≤ 0 (2009)	0	0	0
lows ≤ 0 (normal)	7.4	10.5	3.8
lows ≤ 0 (record)	21	37	11
year(s) of record	1993/1994	1884/1885	1912

The frequency of days with lows below freezing is not as significantly greater than normal (Table 2). This is likely due to the absolute limit of 90 days that can be attained (except for leap years). It therefore is not surprising that only 3 winters in the past 20 years had more days with lows below freezing.

The frequency of extremely cold days (lows at or below zero) was well below normal (Table 2). Most of the winters from 1959/1960 through 1984/1985 averaged at least 4 days per winter with lows below zero at Muskegon. At Grand Rapids, most of the winters from 1959/1960 through 1984/1985 averaged at least 10 days with lows below zero. Lansing experienced nearly two weeks of lows at or below zero from 1959/1960 through 1984/1985. Since 1985/1986, the average has been around 5 days per year at Grand Rapids, 4 days at Lansing, and 2 at Muskegon.

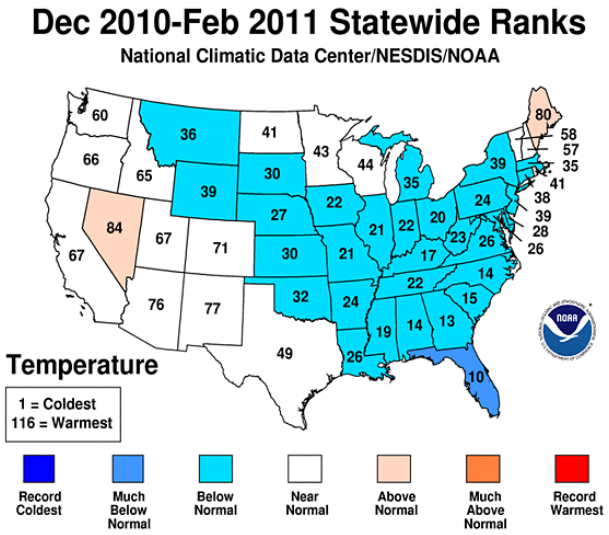


Figure 2. The winter 2010/2011 statewide temperature ranks for the lower 48 states.

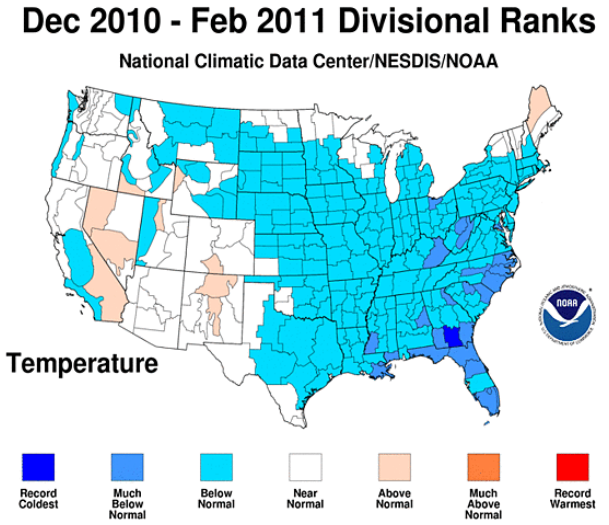


Figure 3. State climate divisional ranks for the winter of 2010/2011.

Most of the lower 48 states were colder than normal (Figure 2). This includes Michigan, which was in the top third of coldest winters. The divisional ranks show a similar result (Figure 3). The observed temperature anomalies (Figures. 2, 3) were quite different from the expected classic La Niña anomalies (Figure 4), particularly in the southeastern United States, which was much colder than expected.

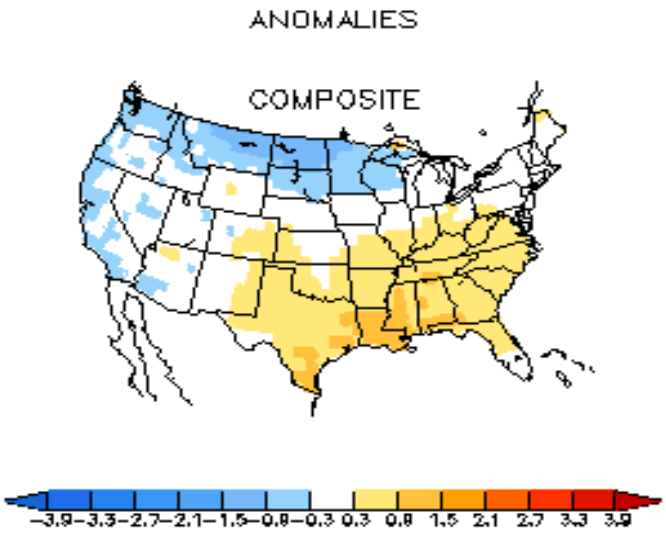


Figure 4. La Niña winter composited temperature anomalies based on seventeen La Niña events since 1950.

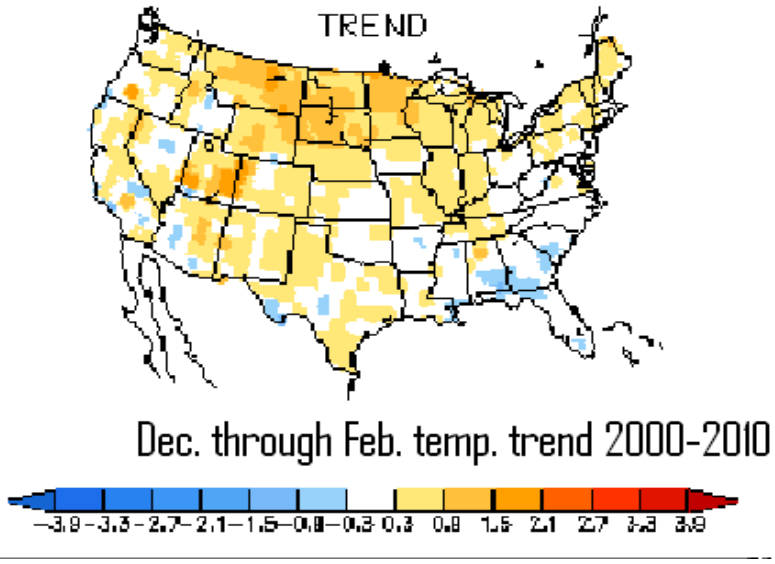


Figure 5. Winter temperature trend. Trend is the mean temperature over the past ten years (2001-2010) minus the 1971-2000 mean.

There has been a trend for warmer winter temperatures for Southwest Lower Michigan over the past 10 years (2000 through 2010) when compared to the 1971-2000 mean (Figure 5). However, the warming trend appears to have slowed down or even reversed in recent years (Figure 6).

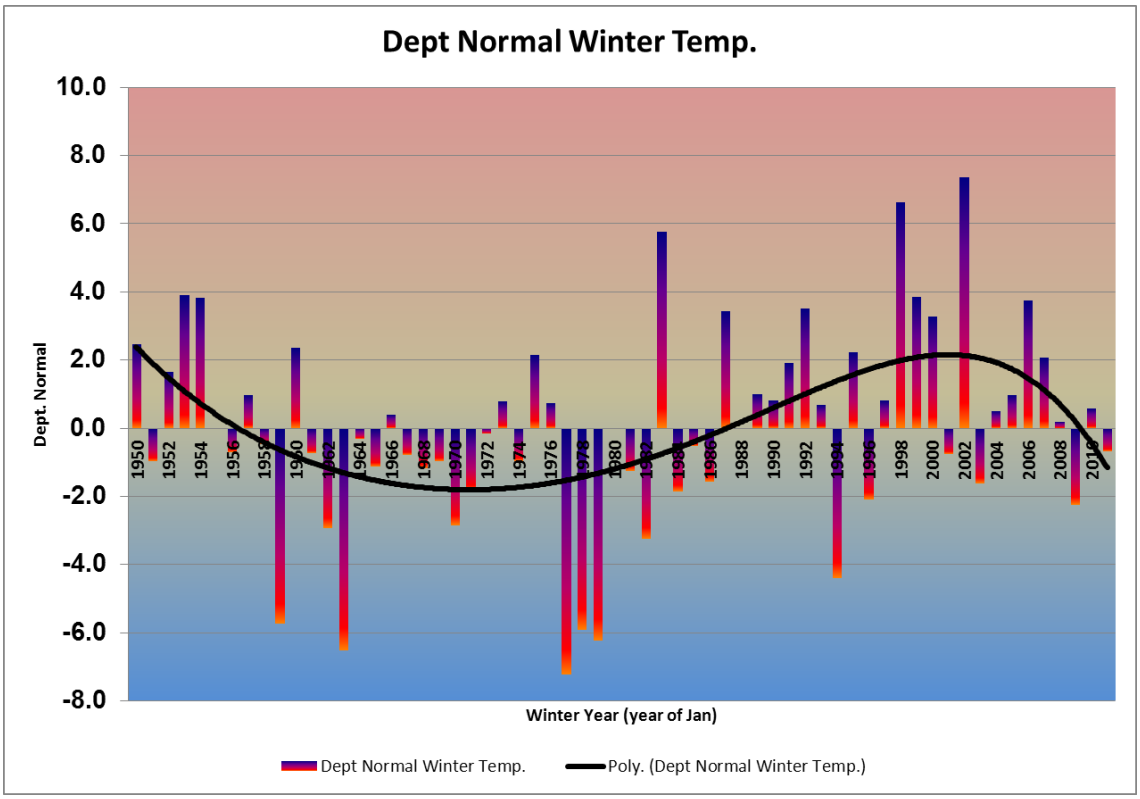


Figure 6. Winter mean temperature departure from normal from 1950 to 2011 using the average of the 36 climate reporting sites in Southwest Lower Michigan.

Daily temperatures were generally near to below normal in December (Figs. 7-9). There was a very brief warm up the last few days of December as a strong storm passed west of the Great Lakes, but then the cold returned and lasted into mid-February before coming to an end. In the last half of February, temperatures fluctuated considerably. Overall, there were very few warmer than normal days.

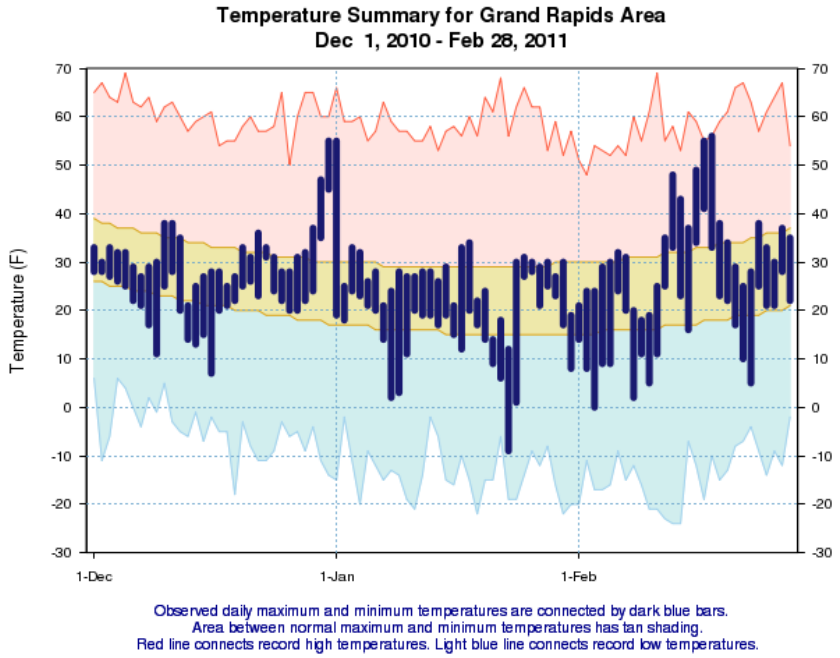


Figure 7. Winter 2010/2011 daily temperatures for Grand Rapids. The daily maximum and minimum temperatures are connected by dark blue bars. The area between the maximum and minimum temperature has tan shading. Red lines connect the record high temperatures. Blue lines connect the record low temperatures.

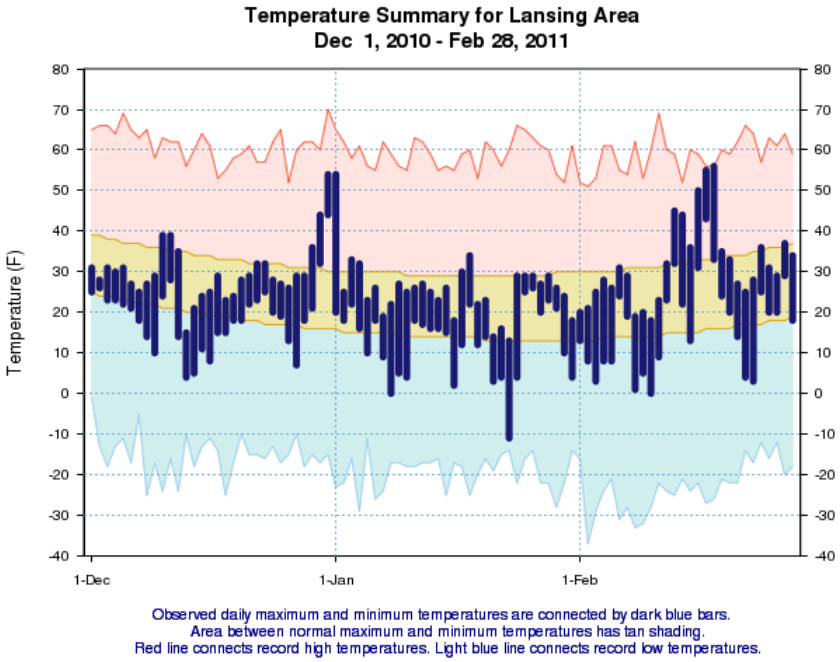


Figure 8. Same as Figure 7, except for Lansing.

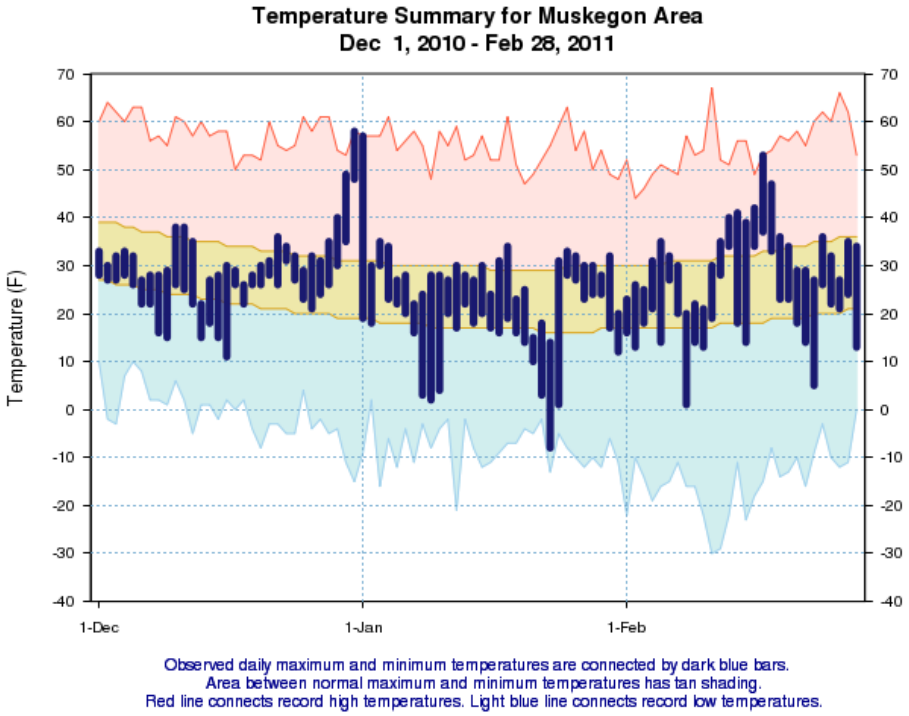
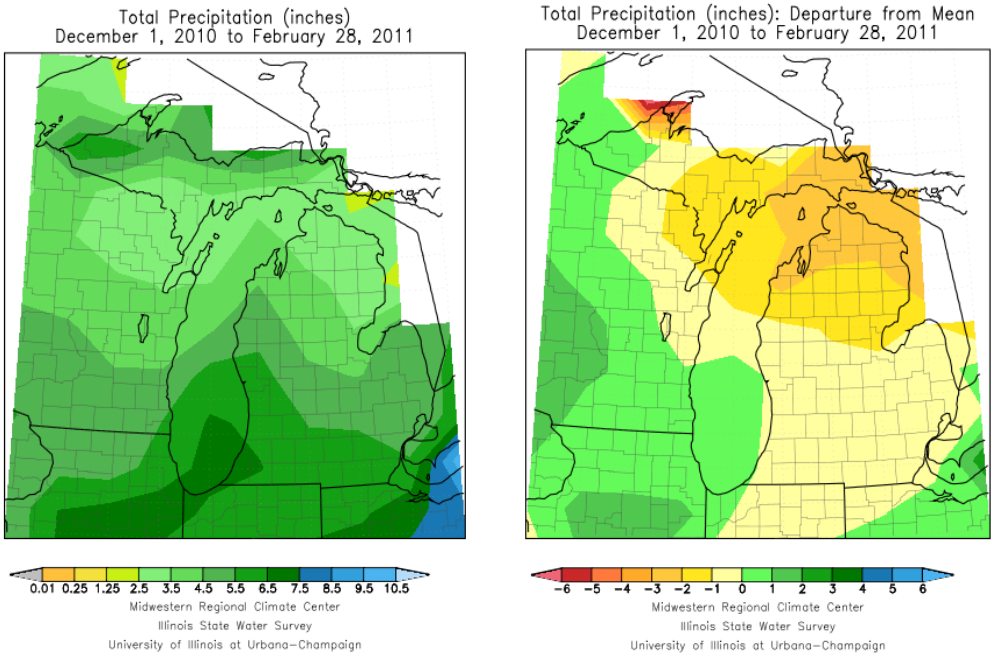


Figure 9. Same as Figure 7, except for Muskegon.

Like the previous winter, the winter of 2010/2011 was drier than normal (Figure 11b). The past two winters reverse a trend that began during the winter of 2005/2006 and continued through the winter of 2008/2009, which was for well above normal precipitation each winter. Drier than normal conditions were more pronounced across northern Lower Michigan. The more western storm track of this winter can be seen in Figure 11, which shows much wetter conditions west of Lake Michigan.

The state of Michigan experienced the 21th driest winter out of 116 years (Figure 12). Looking at the four climate divisions that make up Southwest Lower Michigan (Figure 13), it can be seen that the southwestern lake shore was near normal, but the other three climate divisions of Southwest Lower Michigan were in the below normal classification. This was similar to what occurred in the winter of 2009/2010.



(a) (b)

Figure 5. Total winter precipitation (a) and departure from normal (b) for Michigan.

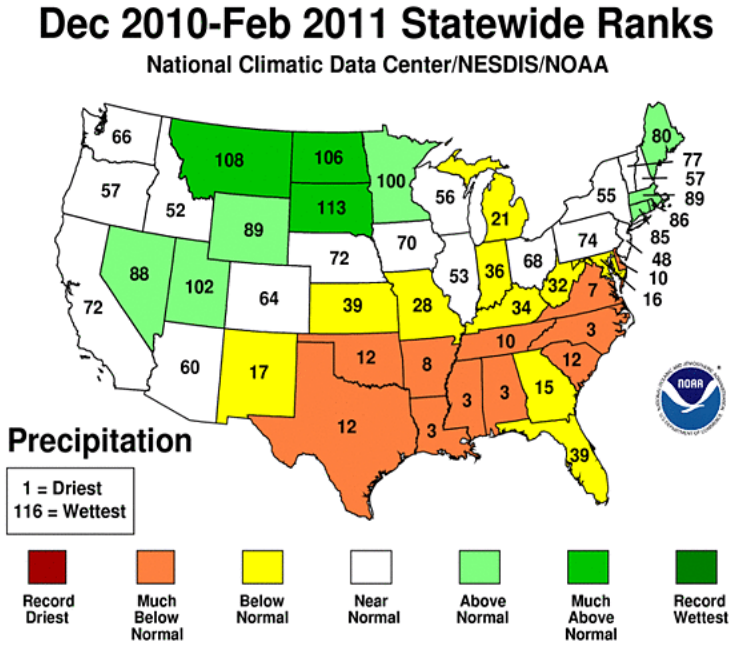


Figure 11. As in Figure 2, except for precipitation.

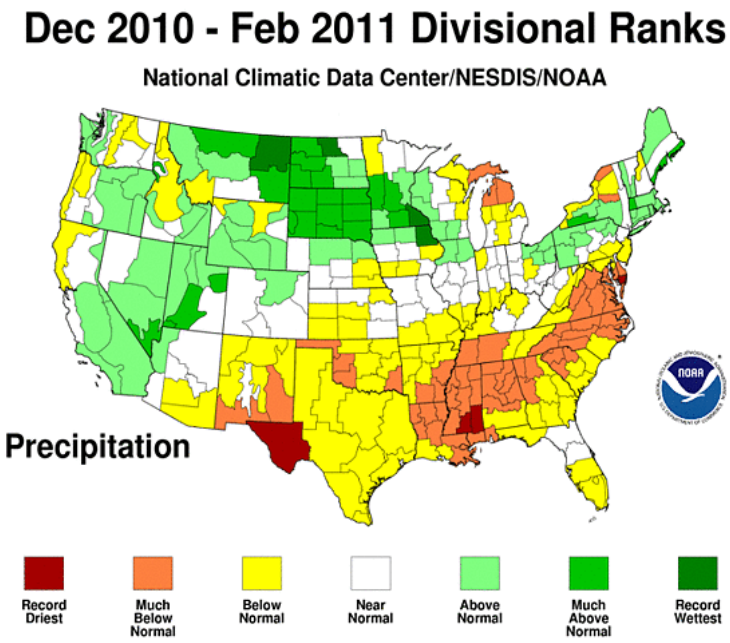


Figure 12. As in Figure 3, except for precipitation.

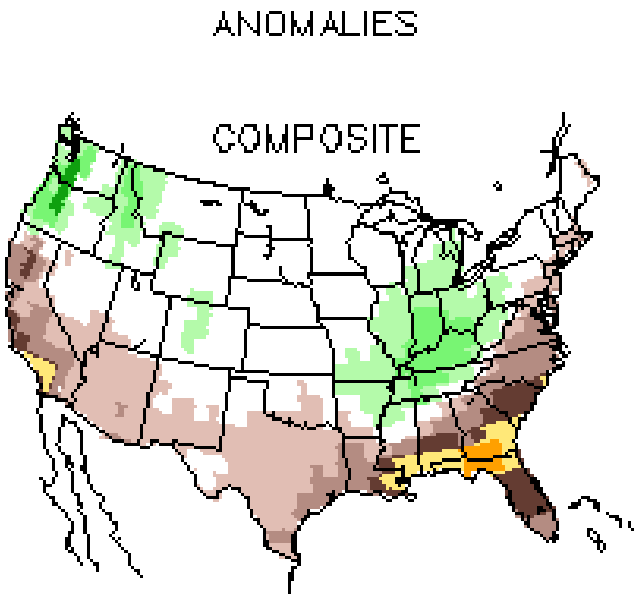


Figure 13. La Niña winter composites for precipitation using 17 La Niña events since 1950.

The typical impacts of La Niña on precipitation (Figure13) were seen this winter over the southern United States (Figures. 12-13), but not over Southwest Lower Michigan. The Ohio valley

storm track, typical of mid to late winter during La Niña winters, never really materialized. Thus, the large, wet anomaly suggested by the La Niña composites did not occur this past winter.

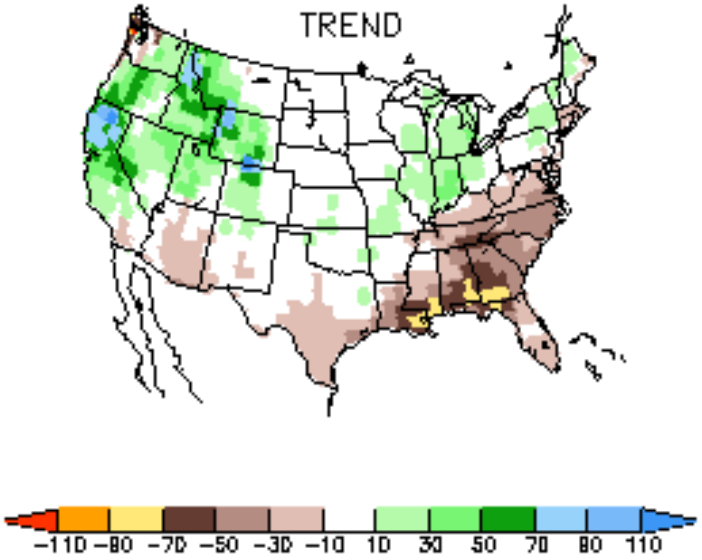


Figure 6 Winter precipitation trend, which compares the last 15 year to the 1971-2000 average.

The precipitation trend suggested a wet winter (Figure 15). However, with the failure of the Ohio Valley storm track, this trend was not realized for the second winter in a row (Figure 16). The decrease in winter precipitation does seem to fit a larger scale cycle shown over the past 60 or so winters. The chart below is based on the mean of 36 long term climate stations so it does not reflect any local station anomalies. It does show our regional trends. Note there is about a 30 year cycle suggested by this date. If the data going back to the late 1890s was included, this 30 year cycle would still be apparent.

Grand Rapids, Lansing and Muskegon all received the heaviest precipitation in February while December and January were dry months (Figs. 17 through 19). Four storms are very apparent in these figures: the rain storm of December 11th and 12th, a rain storm on the December 31st, a blizzard on February 1st and 2nd, and a snow and ice storm around February 20th.

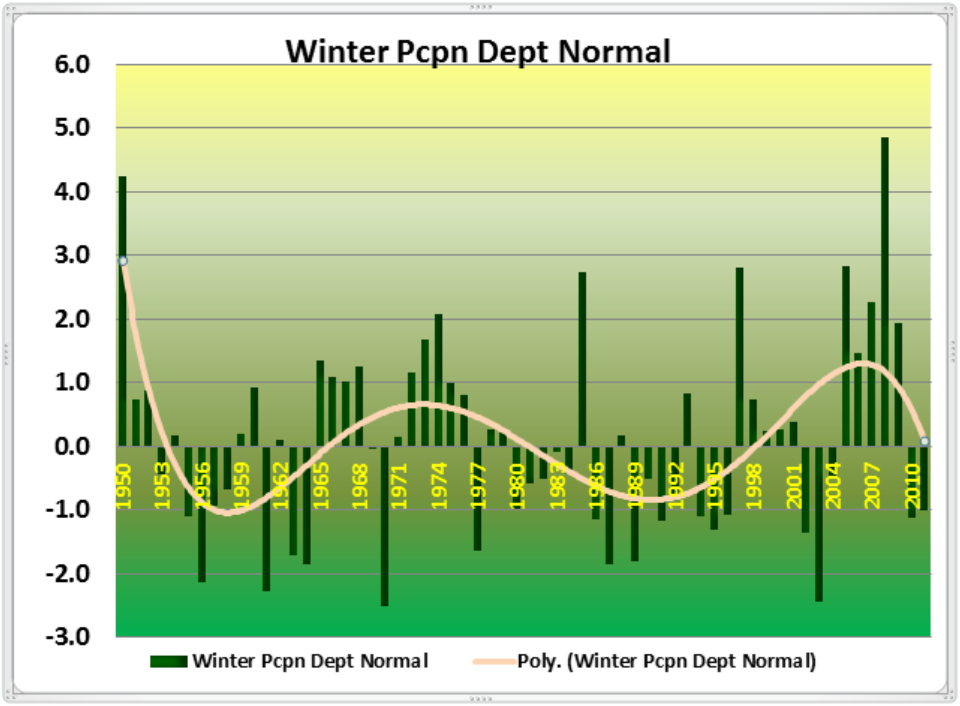


Figure 7. Total winter precipitation departure from normal for all of Southwest Lower Michigan from 1950 through 2011 (most recent trend period).

Lansing's precipitation pattern was very similar to Grand Rapids with those same four storms being very prominent. Both Lansing and Grand Rapids were below normal in terms of total precipitation. Unlike Lansing and Grand Rapids, Muskegon had frequent lake effect snow events in January. Even though the December precipitation pattern looks similar at all three climate sites, lake effect snow became very prevalent, resulting in some precipitation (almost entirely snow) nearly every day. The blizzard on February 1st and 2nd, combined with the snow storm on the 20th, allowed Muskegon to remain above normal through the rest of the month of February. Muskegon was the only primary climate site to end the winter wetter than normal.

Snowfall was concentrated near the lakeshore (Figure 20), and well above normal across all of Southwest Lower Michigan (Figure 21). The lakeshore area from Muskegon to South Haven was as much as two feet above normal, Lansing was over a foot, Grand Rapids a foot and a half, and Muskegon nearly two feet above normal. Most notable was the blizzard of February 1st into the 2nd, which resulted in 10 to 20 inches of snow and had wind gusts near 50 mph causing roads to be closed, flights to be canceled or delayed, and many schools and businesses to close. That was one of the bigger snow storms since the Blizzard of 1978.

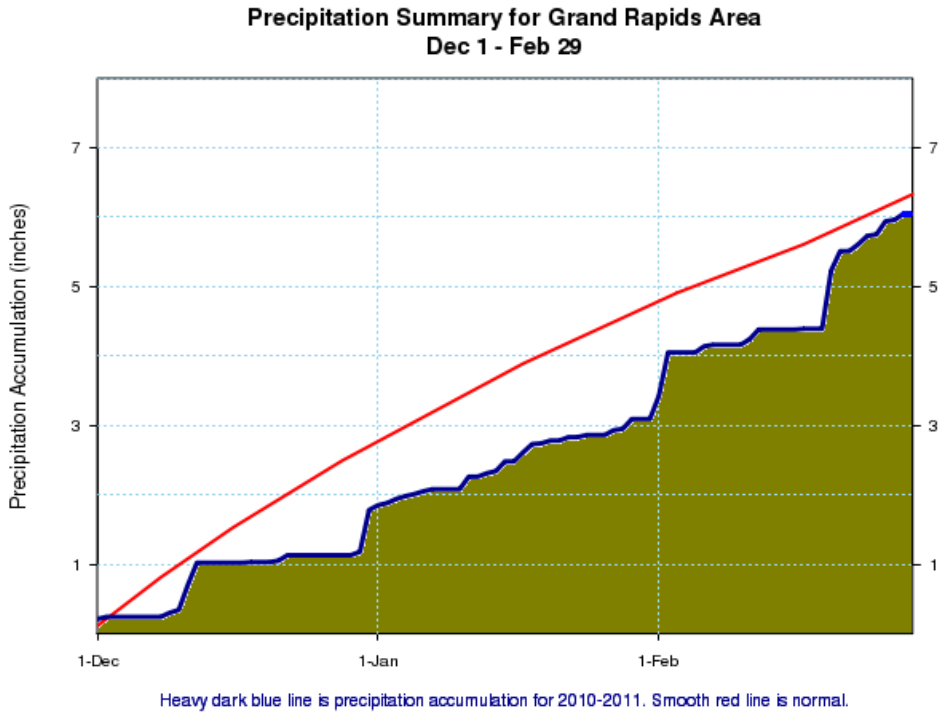


Figure 8. Grand Rapids daily precipitation accumulation for the winter of 2010/2011.

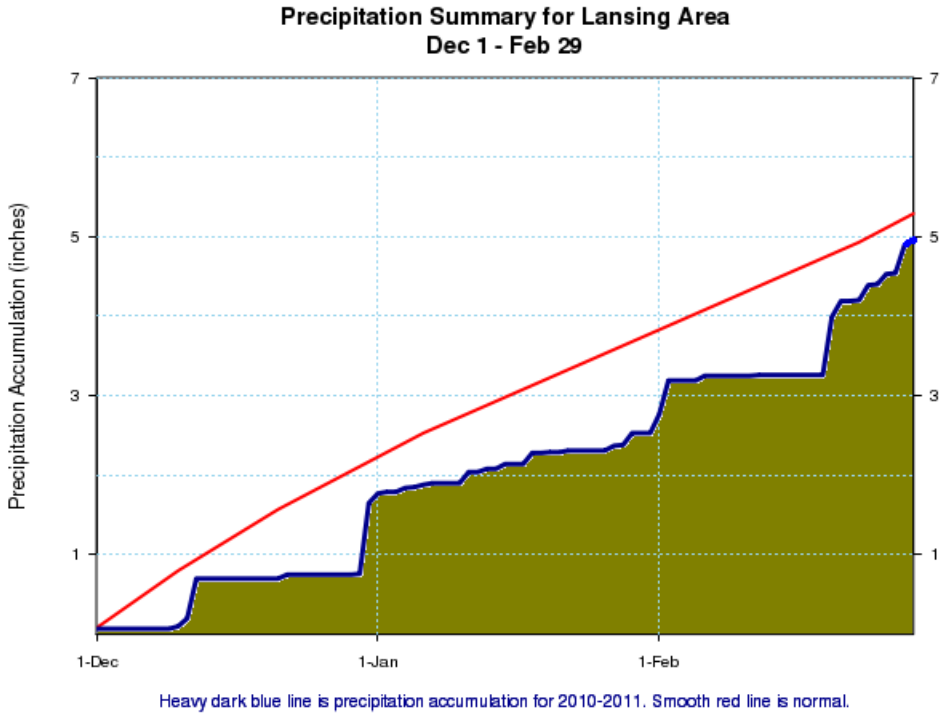


Figure 9. As in Figure 17, except for Lansing.

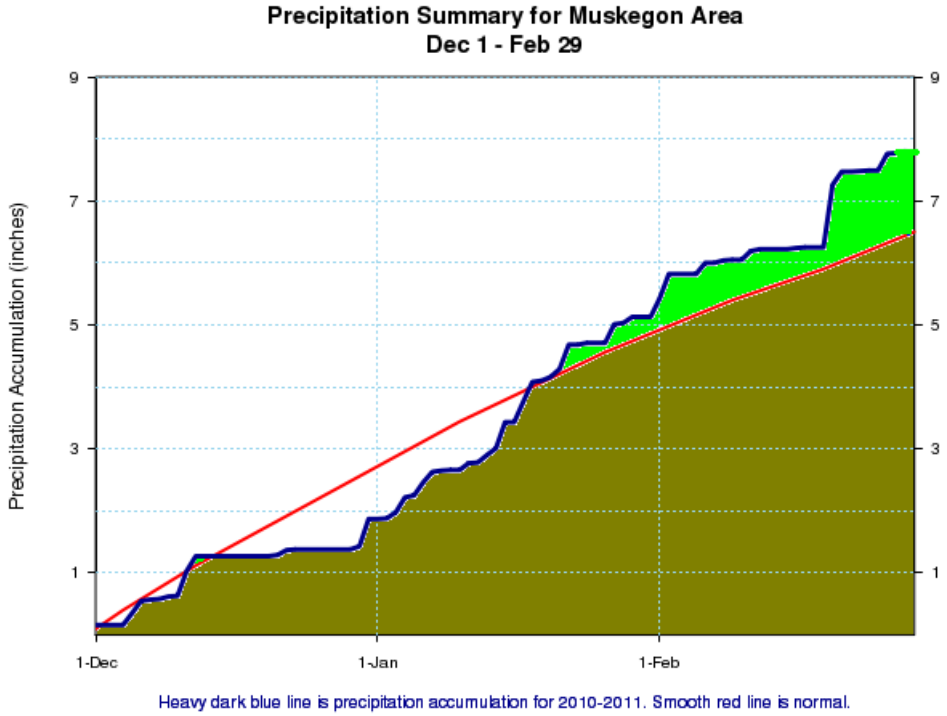


Figure 10. As in Figure17, except for Muskegon.

Overall, the snowfall in the winter of 2010/2011 started slowly, which is typical with a strong La Niña influence (Figure 22). February was a very active month, which boosted seasonal snowfall totals. The trend towards a snowier second half of winter followed the expected anomalies composite and frequency (Figure 23). The February blizzard earned its place as one of the most significant on record in terms of accumulation and impacts to travel and commerce. Lake effect snow played a vital role in raising totals considerably along the lakeshore.

In summary, for the winter of 2010-2011, Southwest Lower Michigan experienced near to slightly below normal temperatures, near normal precipitation, and above normal snowfall.

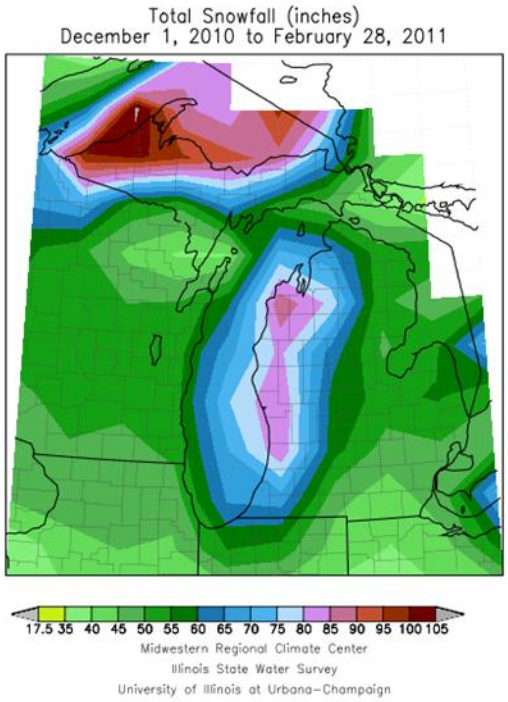


Figure 20. *Winter total snowfall.*

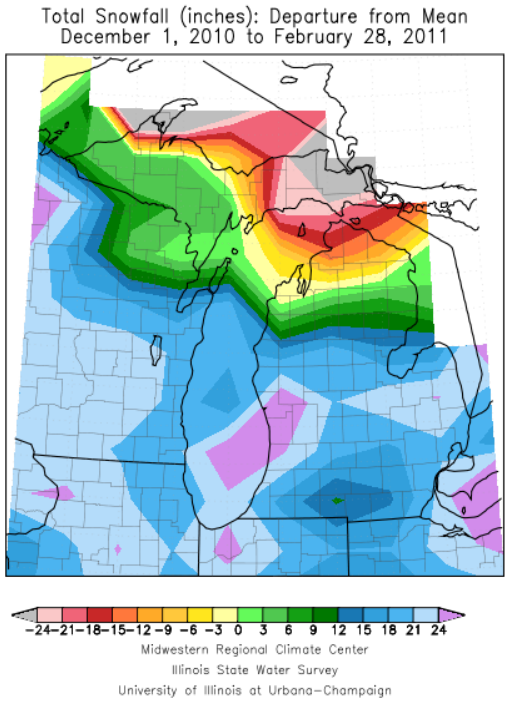


Figure 11. *Winter total snowfall departure from normal.*

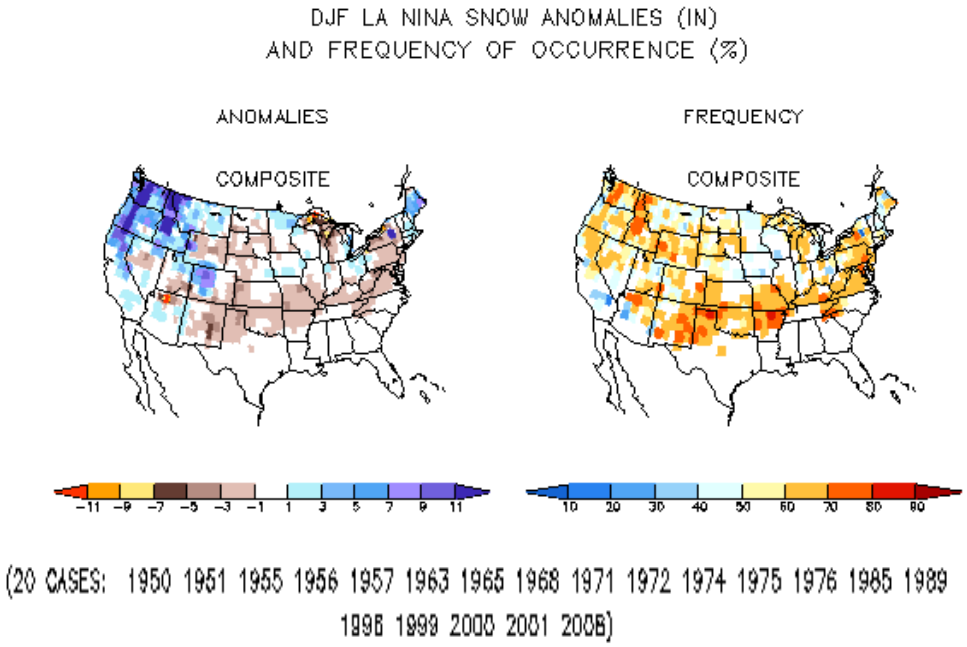


Figure 12. La Niña winter composite for snowfall based on 20 La Niña events since 1950.

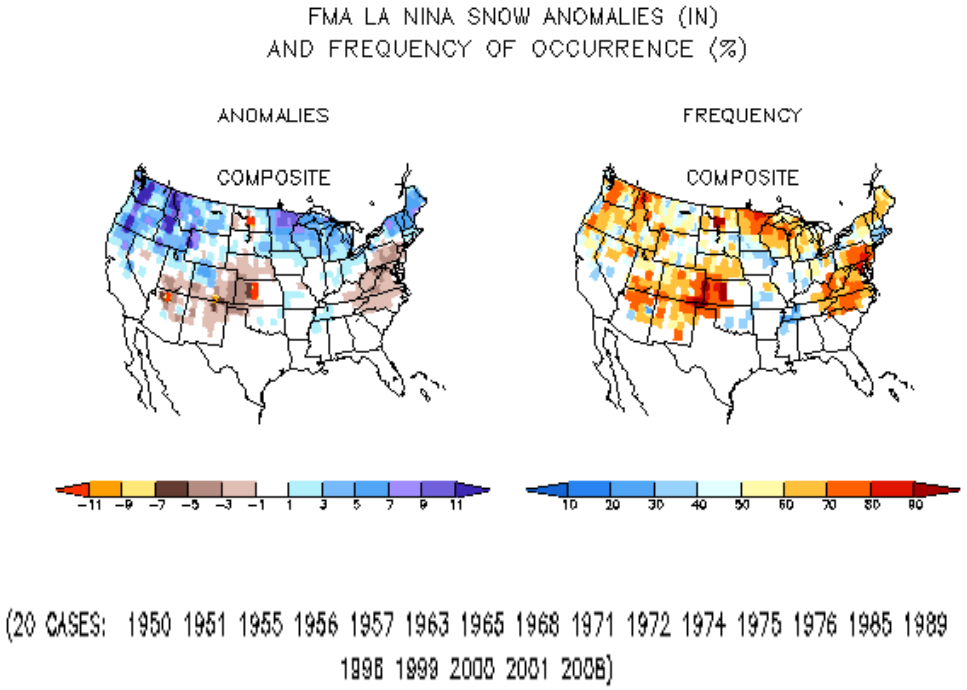


Figure 13. La Niña February through April composite for snowfall based on 20 La Niña events since 1950.